Progress Report No. 8

December 22, 1963 to June 30, 1964

Effect of Pressure on Metallurgical Phenomena

NASA Grant No. NsG-90-60

Transformations in Alloy Systems:

I. Tl-In System

As was reported in Progress Report #7 work on the Tl-In system was completed during the early part of this reporting period and the results presented at the AIME Annual February meeting. Mr. Philip Adler, the graduate student working on the program submitted his doctoral dissentation, which was accepted, passed his thesis defense and received the Doctor of Engineering Science Degree in June of this period.

II. Tl-Pb System

Mr. Bernard Siegel took over as graduate student on March 1, 1964 and is working on the Tl-Pb system in order to provide some information on the alloying behavior of thallium as a function of temperature and pressure.

Twenty-three Tl-Pb alloys covering the range of compositions from 60 to 100% Tl. Eight of these alloys have been processed to wire for use in pressure-temperature experiments.

There is some uncertainty in the atmospheric pressure diagram and therefore these uncertainties must be clarified before the high pressure work can be undertaken. It is planned to study the Tl-Pb system at atmospheric pressure by both X-ray and resistivity techniques. A resistivity apparatus is now being constructed.

Mr. Siegel has familiarized himself with the operation of the tetrahedral pressure apparatus by repeating some of the calibration runs conducted earlier by Mr. Adler. Mr. Siegel is now fully familiar with the operations of the apparatus.

III. Tl-Hg System:

We will have some opportunity to work on the Tl-Hg system this summer since an NSF program for research by high school science teachers is in effect at New York University. Any information of significance to this program will be noted.

Part B. STUDY OF PbTe and $Sn_xPb_{(1-x)}Te$ ALLOYS IN THE RANGE $0<X<0.3$ UNDER HIGH PRESSURE

To study the effect of pressure on the thermoelectric properties of the alloys a pressure cell was built in which current is passed through the crystal to create a temperature difference.

However, it was found that the high pressure cell conducted the heat so fast that a large enough temperature difference was not built up between the two ends of the crystal. A measurable Seebeck voltage could therefore not be detected.

In addition, the contact resistance between the thermocouple tip and the crystal was very large and no change in resistance due to increasing pressure was detected.

Because of these problems, the design was modified as follows: Two concentric graphite furnaces were separated by a concentric BN cylinder. The outer furnace which can be heated up to about 500°C heats up the specimen. The inner furnace is tapered; ie: one end of the wall being thicker than the other, and this creates a temperature difference. The furnace has been tested and a 3 - 4°C temperature difference can be maintained at temperature.

After modification, a shorting problem between the two furnaces arose, but this trouble has now been overcome. Some shorting between the inner furnace and the thermocouple wires has been located and is in the process of being eliminated.

The contact resistance independent four point probe arrangement cannot be applied to our high pressure cell due to the limited spacing provided by the cell. To minimize the contact resistance a second method was tried; the thermocouple wires were soldered into a brass block, the block was then pressed against the crystal and contact was established. We find in this way that the contact resistance is minimized. However, it was found that the soft solder contaminated the specimen. Mechanical bonding between the thermocouple wires and the brass block is being tried in order to eliminate the solder contamination.